Edinburgh Health and Social Care Partnership

Pain Management Service

Understanding Pain– Webinar Handout

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Aim

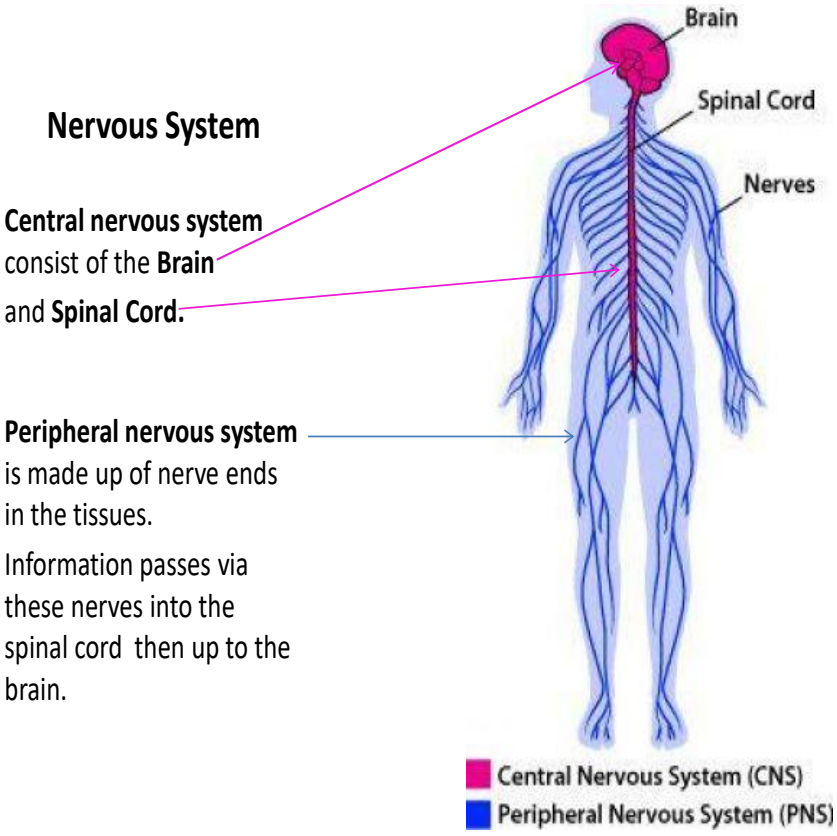
This webinar aims to help increase your understanding of how the nervous system produces pain and how the system can become sensitised over time.

"No pain = No Gain"

"Know Pain = Know Gain"

Topics covered:

- Body has a Pain System = "Threat system"
- "Know Pain = Know Gain"
- Peripheral and central nervous system
- Nerve ends = sensors in the tissues
- Nerves carry information to the spinal cord and brain
- Nerves have chemical "junctions or gates" called synapses
- Brain is a data processing centre
- The nervous system is adaptable – how pathways form
- Sensory map in the brain = homunculus
- Wind up and wind down of the nervous system
- Sensitisation of the threat system
- "Hurt does not always equal harm"
- It is possible to retrain the nervous system...



The body has 2 main parts for its Pain or Threat System

The peripheral and **central nervous systems.**

The peripheral nervous system or sensory nervous system has nerve ends continually monitoring the tissues for danger and sending signals to the central nervous system.

The central nervous system is made up of the spinal cord and brain
This part of the nervous system receives incoming information from the sensors in the tissues via the peripheral nervous system and relays the information up to the brain.

The brain is considered to be the data processing centre where all the information is analysed as it arrives.

The Brain's processing centres analyses the information and literally make sense of the incoming information.

Detector system

Temperature sensors

Pressure sensors

Chemical sensors

The peripheral nervous system has nerve endings in the body's tissues.

The nerve ends monitor changes in Temperature, Pressure and Chemicals and send electric impulses or danger messages to the spinal cord which can be sent up to the brain.

The nerve ends in the Body's tissues are constantly monitoring or sensing changes:-

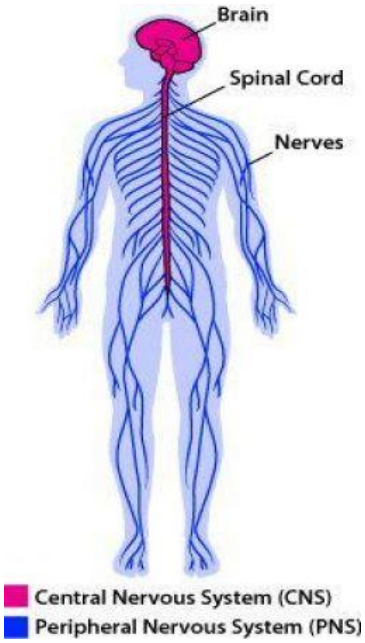
For example
Temperature sensors = makes you take your hand off hot surface to prevent burns and tissue damage.

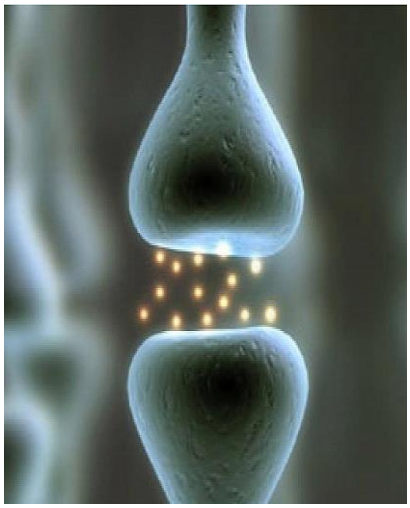
Pressure sensors = causes us to change position before pressure builds up to a level that would cause damage therefore preventing the skin from developing pressure sores.

Chemical sensors = picks up changes in the chemicals present in tissues which might be due to inflammation or due to external threats, like if a bee or nettle stings occurs.

The nerve ends in the tissues are like "sensors in a smoke detector system constantly sensing danger and alarming to prevent damage". When they are triggered they send electrical signals into the spinal cord via "a junction box" or "relay centre".

When a strong or important enough electrical impulse arrives at the junction box in the spinal cord it will relay the signal further up to the brain where the data processing centre makes sense of the message.





Nerves are not continuous cables like from a light switch to a light bulb.

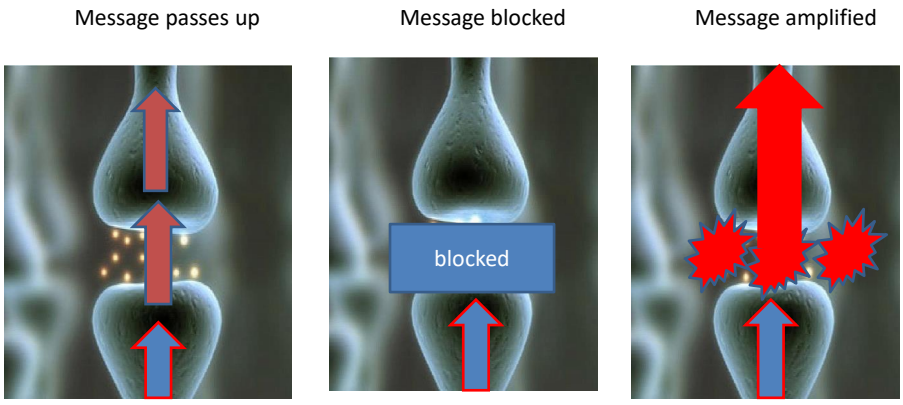
There are small junctions at various points along the nerve pathway - these are known as synapses or chemical gates

When the signal from the sensors in the tissues reaches the spinal cord it has to pass through a junction called a “synapse” or chemical gate.

As the electrical impulse travells along the nerve and arrives at the junction, it triggers the release of chemicals which travel across the gap and allow the message to continue up to the brain.

These junctions at the spinal cord can be open or closed depending on the strength of the signal arriving at the junction.

The junctions or gates can also be influenced by other factors.....



What stops the signal being sent up to the brain?

Not strong enough or important enough
Temperature, pressure or chemical sensors may send impulses to the spinal cord junction box. However if the signal is not strong enough it will not trigger the release of the chemical messengers, and the signal will not cross the junction.

If the impulse is strong enough it will cause a release of chemical messengers which will flood across the junction and trigger the impulse to be sent higher up to the brain. If the brain concludes that the message is threatening it may decide to react by producing a pain experience.

What amplifies the signal?
If the impulse is strong and keeps arriving at the junction in the spinal cord, this can cause a lot more chemical messengers to be released into the junction. These spill out into the surrounding area and start to wake up dormant (sleeping) nerve ends around the junction. This can cause the message being relayed up to the brain to become **amplified and much stronger as other nerves start to carry the message.**

FACT:
When scientists learned about the chemical junctions in the nerves, they were able to develop drugs (chemicals compounds) which could block chemical messengers from being released, preventing the signal being passed up to the brain (literally blocking the chemical gates from working). Doctors prescribe these medicines and they can be effective in the management of some acute pain.

The brain is a data processing centre

No Brain = No Pain

Even once the impulses reach the brain, there are times when the brain may not react to the message by producing pain.

If the brain is distracted, too busy with other thoughts/activities or threats, it may decide that experiencing pain would be unhelpful:-

- Would I notice a sprained ankle if I was about to be run over by a bus?
- Would I notice a sore back if I was being attacked by a wild animal?
- Have you ever undressed and noticed a bruise but been unable to remember how it got there?

Pain responses are very complicated and not direct cause and effect.

When the message arrives at the brain it is relayed to many different areas.
There is no one PAIN CENTRE in the brain.
These areas are responsible for sensation, memory, emotion regulation and much more.
The brain processes, and has to make sense of, the information and uses lots of different areas to analyse and predict what's going on.

The brain is considering…

- How dangerous is this?
- What happened the last time I felt this?
- How important is this?

Only once this data processing has happened will the brain respond by sending out an experience of pain.

This is why we consider Pain as an output from the brain

The nervous system is adaptable

pathways form and develop in the nervous system

Nerves that fire together wire together, and make even more connections

The picture in the presentation shows a field where a path has been worn – the more that it is used the more embedded and wider it becomes – once the pathway is established it takes a lot to change the habit and create a new pathway. It's always easier to choose the well worn path.

The way that pathways are formed works for good and bad habits in exactly the same way. We all know how difficult it is to unlearn a bad habit!!!

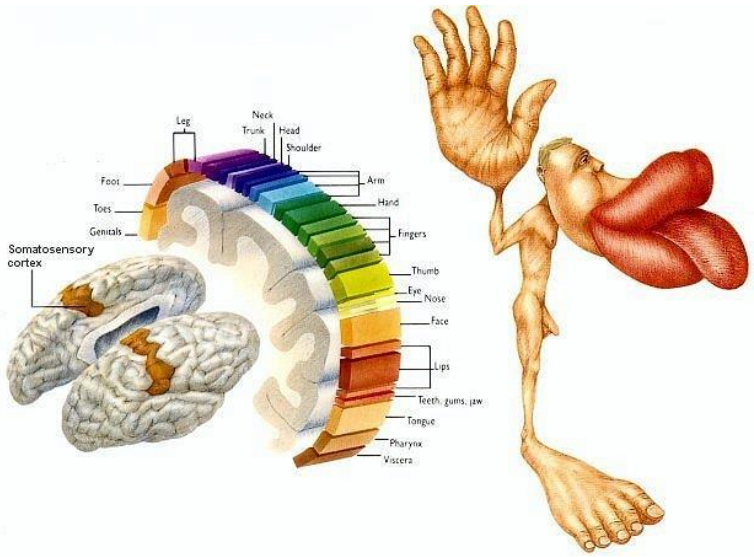
Science has shown that this works for the threat system too!
The more we experience pain the better the nervous system gets at producing it – it can become an automatic reaction even when there is no apparent threat.

The next page shows how experiencing flare ups of pain can gradually lead to an increasingly sensitised nervous system.

The good news is that there are ways to retrain the nervous system .....

The sensory map in the brain…

The Homunculus – Plasticity!



The brain has an area where the body is mapped out, this is shown in the picture. Some parts of the body like the hands and lips have a lot more nerve ends due to their function. This means that they link to a large area in the brain = proportional representation.

The sensory area of our brain is called the sensory cortex and the model of the representation creates this model or homunculus.

Scientists can see from scans that the area in the brain which represents an injured finger becomes enlarged in the area in the brain, then during the healing period it returns to the usual size once healing has occurred.

Imagine a big spot on the end of your nose – how does it feel?
People often say their nose feels bigger while the spot is there - due to the attention you give it and the representation in the brain – this returns to normal once the spot has cleared up.

Fact =
The brain can change and adapt rapidly – however when pain becomes chronic the area responsible for awareness can remain enlarged.
Sensation is complex and this can be observed when a person loses a limb = phantom limbs are still felt by some patients – this is due to the fact that **the physical limb is lost but it still has a place on the map in the brain.**

"wind up and wind down" of the pain/ threat system

Once the signal arrives at the brain, the information is processed:-
The brain has to predict ...while being influenced by context .....
Is it necessary or helpful to produce pain??

WIND UP AND WIND DOWN

The brain can be wound up and react to the messages coming in to its data processing centre and alter the response depending on the context or how threatening the message seems to be..... The nervous system can be wound up or down.

Imagine if am relaxed and watching a boring TV documentary and a member of my family comes into the room and unexpectedly taps me on the shoulder – I might respond by saying "Hello, I didn't hear you coming into the room"

However if I am watching a scary, spooky film and get the same tap on the shoulder I might react quiet differently due to how wound up I have become!

Same stimulus but completely different context....! Wind up and wind down of the nervous system.

Things that amplify or Winds up the signal?

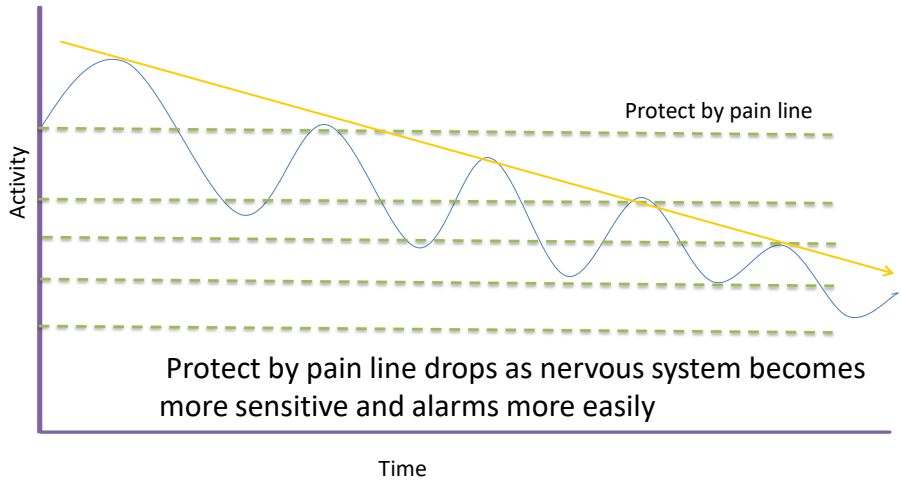
- Stress
- Anxiety
- Worry
- Fear
- Previous bad experience
- Lack of sleep
- Lack of activity

Things that reduce or Winds down the signal?

- Feeling safe
- Confidence and knowledge that you know what this means.
- Previous good experience
- Support / understanding
- Good quality sleep
- A laugh with friends
- Movement and exercise

People often notice that if they are stressed their pain can feel worse but if they are distracted they don't notice their pain as much.

Sensitisation of the nervous system



Over time the nervous system practices pain and becomes sensitised i.e. easily triggered. People find that it takes less to trigger the pain and it feels like the pain becomes much worse – often the pain is the same but takes it takes less to trigger the response.

The threat system is a bit like an over sensitive burglar alarm or smoke detector once it is triggered it is "an all or nothing response".
It can't determine between a cat or an armed burglar it's an all or nothing response.

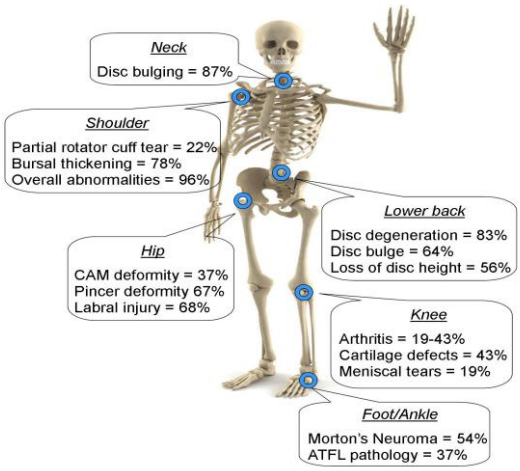
Understanding more about the nervous system will help you understand the importance of trying new strategies to retrain the nervous system.

If your new knowledge and understanding can reduce the threat and recognise that the sensitivity of the alarm system is part of the problem then this can be helpful in adjusting the brains response to the incoming messages from an over sensitive nervous system.

MRI's

These are MRI scan findings in people WITHOUT pain

'Changes are seen in most pain-free individuals.. most of these changes are normal ageing



The scan ≠ amount of pain a person feels

Since the ability to X-ray and scan the body, Dr's have the ability to rule out serious problems like broken bones and tumours etc.

Some people will have scans or X-rays which indicate some ageing or wear and tear but report no pain while others have completely normal scans and report severe pain.

Over time it has become apparent that what is seen on the scans cannot be used as a way to accurately predict the amount of pain a person will be experiencing.

Pain is complex and unpredictable and influenced by many different factors.

What we hope you will take away from this presentation is:

- The threat system is designed to protect the body.
- There are a number of points in the threat system where the message can be amplified or reduced.
- There are a number of things that wind up the nervous system and sensitise the alarm setting, as well as things that can wind it down.
- The brain's data processing role plays a big part in how much pain you feel.
- Pain is not a good predictor of the degree of damage in the tissues i.e. hurt doesn't equal harm
- Pain is complex and unpredictable
- The nervous system learns by practice "things that fire together wire together"
- The nervous system can be retrained.

"No pain = No Gain" 

"Know Pain = Know Gain" 

Future webinars go into the strategies that help to retrain the nervous system.